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A Day in the Life: Post-Master's Student

Presented by Kai Williams

November 16, 2017

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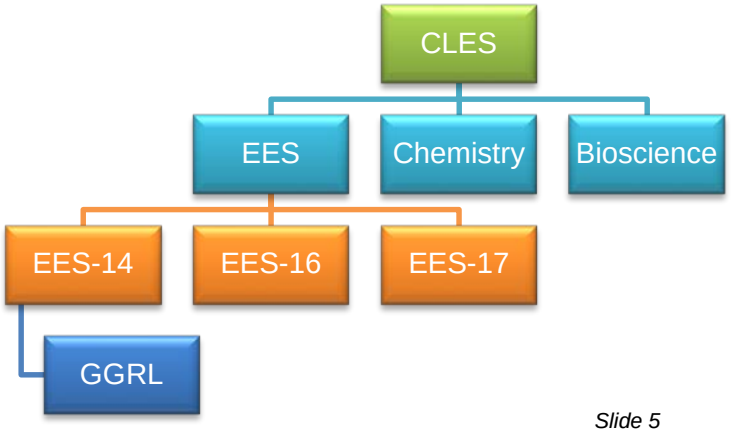
Background

- Raised in San Antonio, TX
  - Born in Oakland, CA
- B.S. in Environmental Engineering from Texas A&M University—Kingsville
- M.S. in Environmental Engineering from New Mexico State
  - Graduate work involved environmental assessments and analytical chemistry
- Interned at UT Arlington, EPA Region 6 and Chungnam National University (CNU)

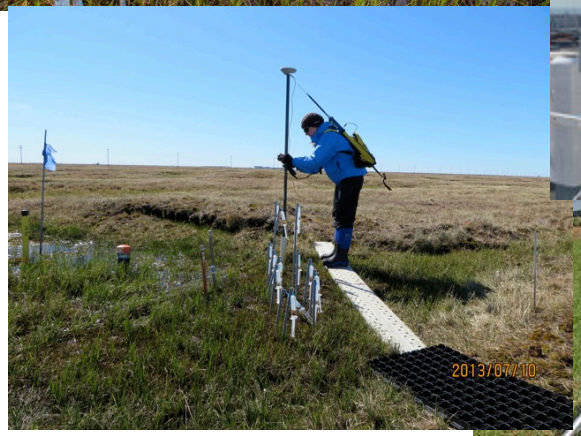
At Work

Earth and Environmental Sciences (EES-14)

- A group under Chemistry, Life, and Earth Sciences (CLES)
- Environmental remediation
- Ecosystem and climate research (NGEE)
  - Conduct field work within the United States and internationally (i.e. Brazil, Panama, Antarctica, Alaska)
- Atmospheric research and global instrument deployment (FIDO)
- Isotope and actinide geochemistry
- Nuclear detonation detection
- Fossil, geothermal, and nuclear energy



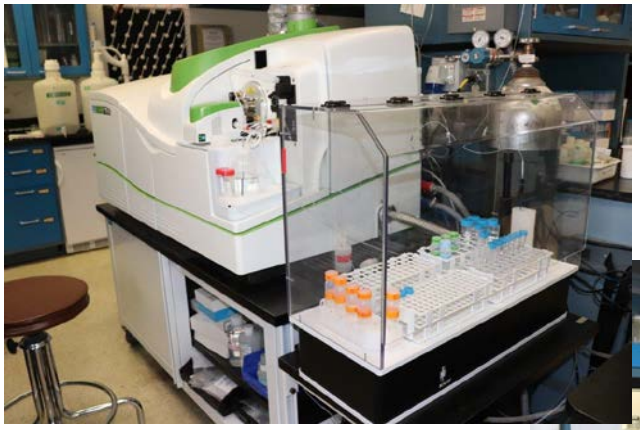
EES-14: Pictures

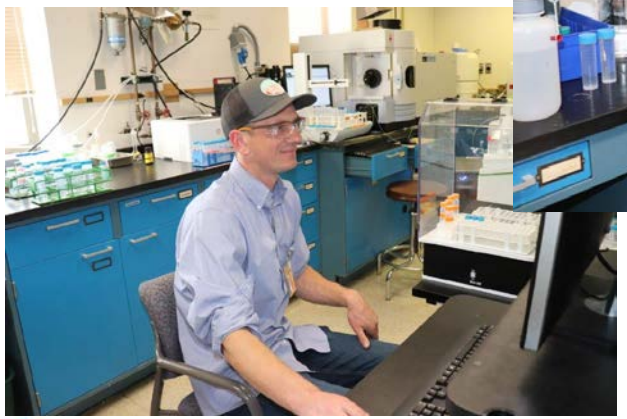


Everyday Life: Analytical Chemistry

- Groundwater and experimental water sample analysis using Inductively Coupled Plasma Mass Spectrometer (ICP-MS) and Inductively Couples Plasma Optical Emission Spectrometer (ICP-OES)
- Support projects related to environmental remediation, environmental monitoring, and NM small business projects.
  - Samples from Brazil, Alaska, Wyoming, Puerto Rico, Colorado, and New Mexico
- Analyze and manage high-visibility data

Wet Chemistry Lab





Mortandad and Sandia Canyon: Chromium

- Reducing chromium in Mortandad and Sandia canyons' groundwater plume (Los Alamos)
  - Dithionite, tracer Studies, column tests
- Treated sanitary wastewater, steam plant effluent, and cooling tower blowdown from LANL Technical Area 3 (TA-03) power plant discharged to Sandia Canyon from 1956-1972—estimated at 0.4 to 1.1 million liters per day
- Wastewater containing perchlorate, nitrate and tritium from LANL's Radioactive Liquid Waste Treatment Facility (RLWTF) discharged to Mortandad Canyon via a tributary called Effluent Canyon
  - Peak discharges 0.2 million liters per day in 1968 which decreased significantly after the mid-1980s and effectively ended in late 2010 (LANL, 2009, 2012).
- Monitoring wells (36 in total) used to collect geochemical data within the regional aquifer
- Wells classified according to total chromium concentration:
  - [Cr]<8 ppb—Background wells
  - [Cr]>50 ppb—Within main portion of chromium plume
  - 8 ppb<[Cr]<50 ppb—Representative of distal edge of plume

Environmental Monitoring Wells

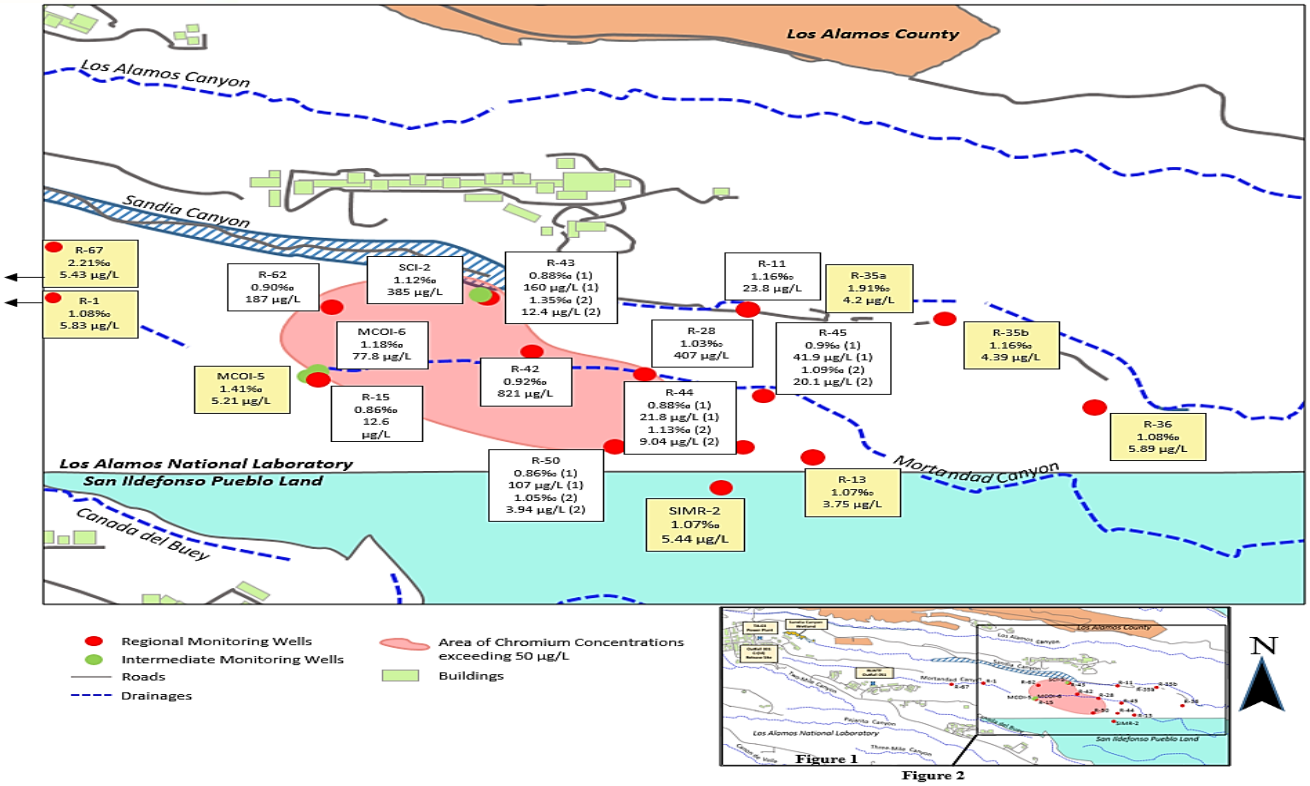


Figure 1. Most recent δ^{53}Cr and Cr concentrations for perched-intermediate and regional aquifer wells in Sandia Canyon and Mortandad Canyon (samples dates from 2007-2016). Where two values are given for each parameter, those followed by (1) are from the upper screen and those followed by (2) from the lower screen of the particular well (see summary tables in appendix for screen depths). Text boxes shaded in yellow represent wells outside the Cr plume that have only natural background chromate present. The red-shaded plume represents the area of the regional groundwater system where Cr(VI) concentration are above the New Mexico Groundwater standard of 50 µg/L

δ^{53}Cr vs. Total Chromium Concentration

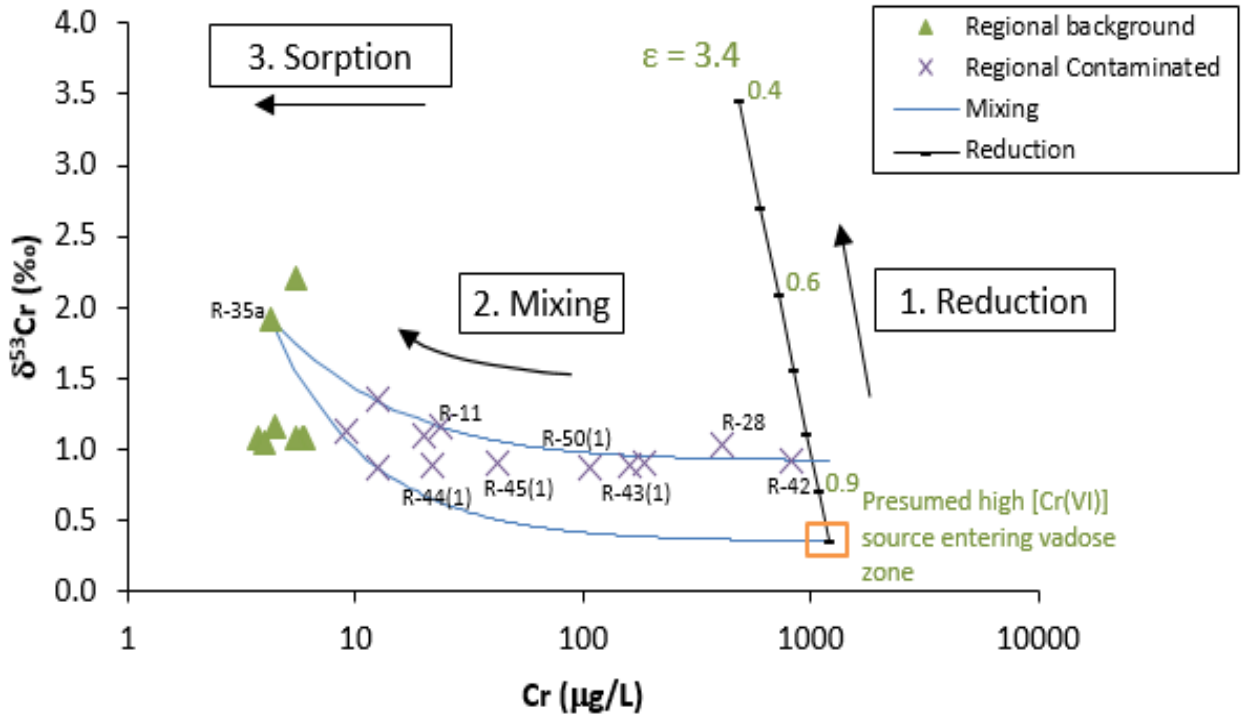


Figure 3. δ^{53}Cr versus total chromium (Cr) concentration for most recent data from each well. Lower blue curve is mixing line between a background water and a highly Cr-contaminated water (open orange box; estimated from the Cr concentration and δ^{53}Cr at well R-42) that has not undergone substantial reduction in the vadose zone or regional aquifer. Upper curve is a mixing line arbitrarily set to mix water from well R-42 with a high δ^{53}Cr background source. The isotopic trend associated with reduction for ε = 3.4‰ is shown, along with fraction Cr remaining as reduction proceeds. The value of 3.4‰ was chosen to be intermediate within the range of experimentally observed fractionation factors. The lack of isotopic fractionation associated with sorption is also shown. Labeled panels with numbers 1, 2, and 3 show expected trends in both δ^{53}Cr and Cr concentration for the processes of reduction, mixing, and sorption, respectively. These processes likely occur concurrently, at least to some degree. Not all data points are labeled to prevent cluttering of the diagram. Total Cr data are used instead of Cr(VI) as these data are more complete and total Cr and Cr(VI) compare favorably in the regional aquifer.

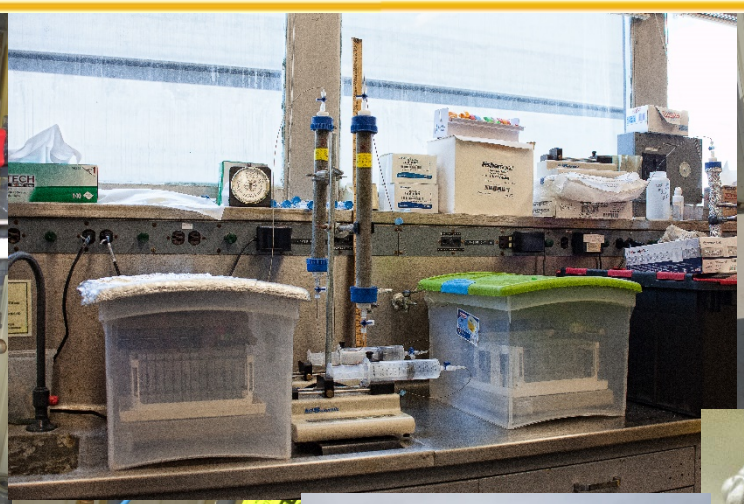
Research Conclusion

- Overall, no evidence for Cr(VI) reduction in the regional aquifer based on the relationships between $\delta^{53}Cr$, [Cr], and Cr(VI) data.
- Given the relevant paucity of evidence for reduction in core sediment leachate data and most Cr(VI) uptake experiments, the simplest explanation is that reduction is not currently or historically significant in the aquifer, even in secondary porosity.
- It could be argued that:
  - The natural attenuation capacity has been overwhelmed within the plume centroid but patterns at the periphery of the chromium plume, where reduction would presumably still be occurring, are not consistent with reduction
  - The fractionation factor in the regional aquifer happens to be anomalously low, perhaps due to high rates of reduction. However, lab studies suggest that the chromium isotope fractionation factor in the regional aquifer is not inherently low.
- The only way the chromium isotope data can be reconciled with the idea of significant reduction in the aquifer would be if reduction were to occur primarily in secondary porosity, with transport limitations leading to a lower effective fractionation factor (if diffusion into secondary porosity is rate limiting a lower effective fractionation factor would be observed

Uranium Reduction Bench-Scale Test and Application

- In-situ uranium mine in eastern Wyoming reducing production and starting environmental remediation projects aimed to reduce uranium within the groundwater
- Experimented by leaching uranium mine sediments to study the effectiveness of dithionite in reducing uranium (3.8 ppm)
  - Continued column test to study how long uranium would stay reduced from initial dithionite injection
- Injected chemicals into groundwater wells
  - Dithionite (reducing agent)
  - Sodium Sulfite (buffer agent used stabilize dithionite in solution)
  - Sodium Bromide (tracer to make sure we recovered everything injected)
- Collected grab samples daily for a month (approx.) to monitor uranium reduction

Rad Geochemistry Lab and In-Situ Mine Site

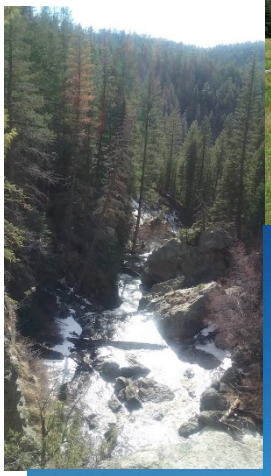
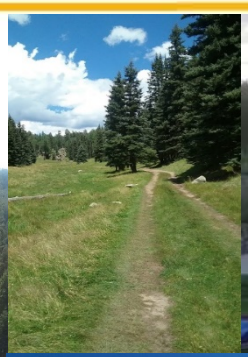


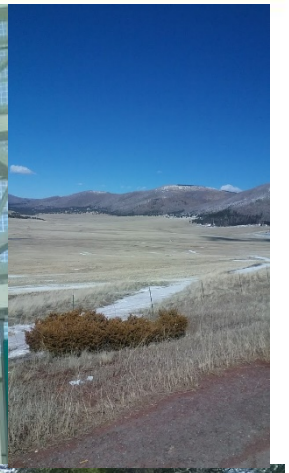
Off the Clock

Off the Clock

- Shoshinryu (Japanese martial arts), ice skating, and hiking
- Karaoke Night
- Language Exchange
- Summer Concerts at Ashley Pond
- Bandelier National Park
- Travelling to Arches National Park (UT), Grand Canyon (AZ), Denver (CO), and Jemez Falls (NM)
- Volunteer Activities
  - Habitat for humanities

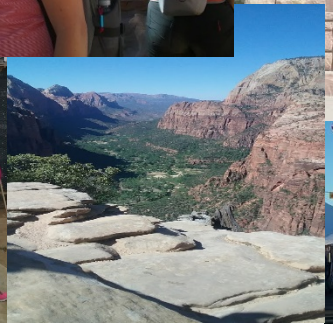
Off the Clock: Pictures










My experience @ LANL

- Relationship with mentor, staff members, students and managers
  - 12 days of Christmas, group lunches, welcome party
  - Group meetings on Thursdays to troubleshoot research obstacles with group
  - Involvement in the science projects within group
  - Opportunity to grow and gain more responsibilities (RC-1)
  - Everybody acts as a mentor
- Professional development and soft skills classes
- Seminars and presentations (Tea &Cookies)
- Student Picnics and events
  - Lab director served hotdogs to students! ☺
- Flexible work schedule (9/80 schedule)

Any Questions?